

however, slight as compared to the great probability of emboli passing through the internal jugular of the same side by aspirating when this vessel is uncompressed. It becomes a question of choosing the lesser of two evils. Since the present case was operated, on several occasions I have had, while operating upon infective sinus and jugular cases, the opportunity to observe more carefully the effect of the above procedure, and to somewhat modify it. When attempting to curette a thrombus from the region of the bulb, pressure should be made not only over the internal jugular of the corresponding side, but over both internal jugulars. By doing this the backward pressure is noticeably increased, and, in addition, the opposite internal jugular to the side of operation should be compressed, either simultaneously with or slightly prior to the jugular of the operated side. By compressing both vessels, the aspiratory influence of inspiration is more effectually eliminated. By compressing the opposite vein immediately prior to its fellow, the venous system of that side becomes primarily congested, and consequently emboli would not so readily be forced through the communicating veins to the opposite circulation. The reverse proposition is likewise to be considered, but I believe pressure over both vessels to be of decided advantage. I do not advocate, however, the attempt to curette the region of the jugular bulb, prior to jugular ligation, after having slit the external wall of the vessel down to a point as near the bulb as possible, and having failed to get a spontaneous return flow from below. To those who insist that this practice is conservative, I believe the above procedure will be of advantage and will lessen the probability of general sepsis.

POSTERIOR-BASIC MENINGITIS.

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THIS peculiar form of meningitis was first brought prominently to the notice of the profession by Gee and Barlow, who, in the *St. Bartholomew Reports* of 1878, described twenty-five cases of meningitis occurring in infants below two years of age. Some of these cases had existed from birth and others occurred sporadically at varying periods. The essential feature of all the cases described was, in the words of the authors, "the holding back of the head." In fact, they called this form of meningitis "cervical opisthotonos of infants," and laid special stress on the holding back of the head as the essential symptom of the disease. They also accentuated the fact that in tuberculous meningitis and other diseases the holding

back of the head was an occasional occurrence, whereas in this form of meningitis it was a constant, unvarying symptom.

In some of their cases the onset had been gradual and in others sudden. In those cases in which the onset had been sudden the opisthotonos alone, or accompanied by fever, vomiting, rigidity of the limbs, and convulsions, seemed to be characteristic. The associated symptoms in their cases included rigidity of the limbs and convulsions throughout the course of the disease. The course of the disease in all these cases was chronic and only three of their twenty-five recovered. The duration of the disease, from its onset to the fatal termination, varied from twenty-seven days to nineteen months.

Post-mortem examination, in all cases in which it could be obtained, revealed the fact that no tubercle existed either in the brain or other organs of the body. There was lymph in varying quantities at the base of the brain, and the ventricles were dilated in most cases. In some cases there was otitis, but the other viscera showed no changes.

As to the etiology, these authors, at the time this paper was written, considered syphilis as a doubtful factor, and ventured the opinion that some of the acute cases with sudden onset resembled "epidemic cerebrospinal meningitis" of the sporadic variety.

In 1897 Carr described a number of cases of hydrocephalus with dilatation of the ventricles of the brain following meningitis, and ventured a theory, to which we will return, as to the cause of hydrocephalus in these cases. His cases resembled essentially those of Gee and Barlow.

In 1898, Still again called attention to this affection in an article in the *Journal of Pathology and Bacteriology* of that year. He mentioned the cases of Gee and Barlow, also stated that the disease occurs sporadically, and is uncommon in England and America, only forty-nine cases having presented themselves during the previous ten years in the Hospital for Sick Children in London. In this article he describes the findings in eight of the cases. He investigated post-mortem the exudate found in the ventricles and in the sub-arachnoid space, and isolated from these exudates a diplococcus which closely resembled the diplococcus intracellularis of Weichselbaum. He thought, however, that it grew more luxuriantly in broth and on agar-agar and glycerin-agar. He failed to find it in some of the chronic cases which had lasted several weeks, and he found it in the tendon sheaths in complicating arthritis in one case.

In describing the disease Still, in this article, considers it as not occurring in epidemics, but rather sporadically, and draws the distinction between epidemic cerebrospinal meningitis and these sporadic cases. In the cases he examined during life herpes and rash were absent. There were some minor differences also between these cases and the epidemic form of cerebrospinal meningitis.

Still laid particular emphasis on the fact that cerebrospinal meningitis of the epidemic type was more rapidly fatal than the posterior-basic meningitis, but that they resembled each other in that they both seemed to affect, by predilection, the base of the brain. He concludes that posterior-basic meningitis is a disease of infancy of a non-tuberculous nature, due to a specific micro-organism, and that this micro-organism is almost identical with the diplococcus of Weichselbaum and Jäger. In other words, he did not think that this disease which we are describing could occur in epidemics. The peri-arthritis which complicated one of his cases was due to the essential cause—the diplococcus intracellularis.

In another article by Still in the *British Medical Journal*, 1898, he further describes the clinical features of these cases. Most of them occurred within the first two years, rarely after the second year of life, and he laid stress on the fact that many of these cases, in London, at least, have been reported as cases of tuberculous meningitis—an experience which the author has had in New York.

Still divides these cases distinctly into those which are fatal within six weeks, those which die after three or four months with hydrocephalus, and finally those which recover. In those cases which are fatal within six weeks post-mortem examination reveals lymph at the base of the brain and cord. In those which die after three or four months with hydrocephalus there is simply a thickening of the pia mater and arachnoid at the base of the brain, some adhesions between the cerebellum and medulla, and slight thickenings on the surface of the temporal or temporosphenoidal lobes. In the ordinary "suppurative vertical meningitis," as he calls it, there are complications elsewhere. In this form rarely so. In fifteen cases of suppurative meningitis there were as complications empyema, pleurisy, pneumonia, ulcerative endocarditis, membranous colitis, necrosis of the petrous portion of the temporal bone, and erysipelas. In two cases of fifteen of basic meningitis there was inflammation of the tendon sheaths, and in one there was an accidental tuberculous focus in some of the viscera. In some of the basic cases there was a mucopurulent secretion in the middle ear, but in none of them was there evidence of mastoid disease or of extension of the ear disease to the brain or meninges.

Still, in this article, laid stress on the bacteriological findings as described in his paper in the *Journal of Pathology and Bacteriology*, and again reiterates the fact that the tuberculous foci found by him in some cases of this disease had absolutely no connection with the primary affection.

In an article on posterior-basic meningitis in Allbutt's *System of Medicine*, Barlow and Lees defined more clearly the pathological changes found in these cases. The inflammation begins at the posterior part of the base of the brain, in most cases, as the primary seat of inflammation, namely, the region where the brain and spinal

cord meet and where the cerebellum overlaps the medulla. From this site the inflammation spreads down the cord to a varying degree, upward along the line of the ventricles, and forward along the base as far as the optic commissure and tips of the temporo-sphenoidal lobes; or the inflammation may begin in the transverse fissure and choroid plexuses. At an early stage of the disease the products of inflammation, though circumscribed, may be suppurative, but later on they may become absorbed and opacities of the meninges with adhesions result. These adhesions may unite the medulla and cerebellum, obliterate the foramen of Magendie and the fourth ventricle. This gives rise to an accumulation of fluid in the ventricles and consequent hydrocephalus. In some of these cases the ventricular fluid is clear and in others it contains flakes of fibrin and pus. In the latter the ependyma is thickened. In some cases the viscera were normal, in others the lungs were collapsed.

In the Cavendish lectures of Osler this author describes a case of posterior-basic meningitis occurring in an older child, considers the etiology and morbid anatomy, but ventures no definite opinion as to the identity or classification of these cases, at the same time noting the work of Still and Gee and Barlow.

The author of this paper has seen a number of cases of posterior-basic meningitis occurring sporadically throughout five years of continuous hospital service. He has never been able to establish, however, until recently the fact, which was doubted by Still, that these cases may occur in epidemics of cerebrospinal meningitis. In the recent epidemic of 1904 the author saw thirty cases of cerebrospinal meningitis in his hospital service. Eight of these were typical cases of posterior-basic meningitis, admitted at various periods of the affection. Some of these cases were as young as four months of age; most of them were below two years of age.

Of the eight cases of posterior-basic meningitis admitted to my service during the recent epidemic of cerebrospinal meningitis the ages ranged from four months to five years. They were, respectively, two infants of four months, one of six months, one of nine months, one child of two years, one of three years, and one of five years. Most of these cases thus were below two years of age. The symptomatology of those above this age varied somewhat from these children and will be regarded in a separate rubric to which we will return later.

The previous history was negative in all of the cases. In other words, there was no history in any case of syphilis or tuberculosis, either in the child or in members of the family. In one case there was a history of ear trouble dating two months before admission and lasting for two weeks, but this had no connection with the illness. In another case the child had had measles three months before admission and scarlet fever a year before this. These

diseases also had no connection with the illness for which the child was admitted.

As to the family history, it has been mentioned that there was no history of tuberculosis or syphilis or anything suggesting the disease in the child, father, mother, or other members of the family. In one case there was a history of miscarriage and of one child of the family having died of meningitis some years before the advent of the present case.

The duration of the disease before admission to the hospital varied in all the cases. One case was admitted the third day after the onset of the disease. This was the case of the child five years of age in which post-mortem examination revealed a form of posterior-basic meningitis, to which we will return. The other cases were admitted seven days, seventeen days, twenty-four days, four weeks, five weeks, and ten weeks after the onset of the initial symptoms.

The mode of onset, speaking now only of the cases below two years of age, which correspond accurately to those described by Gee, Barlow, and Still, in only one case was gradual; in all the others it was sudden. The child was taken with fever and vomiting, then it was noticed that there was rigidity of the neck, and in some cases convulsions occurred. These convulsions were repeated in one case daily for two weeks, the child being quiet in the interval of the convulsions. In other cases after the initial fever and vomiting the child became stupid; then the mother noticed that the fever continued or that the child became blind—in other words, did not notice or see things about it. Nourishment was taken by most cases at the time of the onset, unless rejected by vomiting. In the case in which the onset was gradual there is reason to suspect incorrect observation on the part of the mother, so that it may be said that in all cases the onset was sudden. In all cases the fever and vomiting were followed by rigidity of the neck, in some cases by convulsions, these symptoms being supplemented eventually by the so-called cervical opisthotonos.

When fully developed the picture of the disease as presented to us in the hospital was as follows: The children were emaciated; they lay quiet, seldom crying out; the head was retracted, there was marked or slight opisthotonos, the upper and lower extremities were adducted, the forearm being flexed on the arm, the thighs flexed on the abdomen, and the wrists and fingers flexed. In some cases the children presented the picture in the upper extremities seen in tetany, the so-called driving position of the hands. In other cases the lower extremities were extended and could not be bent, although the upper extremities would be strongly flexed. In the extended position of the lower extremities the thighs could not be flexed, nor could the lower extremity be flexed at the knee. The foot was strongly extended on the leg and the toes flexed into the plantar

surface of the foot, resembling the tetany position. Sometimes the body would be curved to an extreme degree backward, the head assuming an angle of almost 90 degrees with the spinal cord. At times this opisthotonos and tetanus would relax and the spastic phenomenon would not be so apparent. As soon as disturbed, however, or if the back were rubbed, the patients assumed again a position of extreme opisthotonos. In other cases, in addition to the picture thus presented, there was a tendency to cross the legs; in others there were purposeless movements of the upper extremities in a sort of arc in front of the face. The fontanelles, if still open, were bulging and the sutures, in some cases in which hydrocephalus had supervened, were pressed apart by the accumulating fluid in the ventricles. In one case spasmodic contraction of the muscles of respiration occurred at intervals to such an extent as to cause a peculiar hissing sound in the larynx and also an extreme bulging anteriorly of the thorax. In some cases there was strabismus; in other cases this was absent. There was no pulsation to the bulging fontanelle above described. As a rule, the lungs, heart, liver, and spleen presented nothing positive. In all cases the emaciation was so extreme that the abdomen was retracted or rigid.

Some of the children presented, as an accidental find, marked rachitis and cranial tabes.

The temperature, in those cases which had lasted for some length of time, would not range above the normal until close to the final issue. In other words, they ran a temperature simulating what is seen in tuberculous meningitis. One case, in the hospital for five weeks, had a normal temperature for three weeks after admission and then presented wide excursions of temperature, as high as $106\frac{1}{4}^{\circ}$, especially after lumbar puncture. These temperatures did not seem to be anything but cerebral temperatures, for lumbar puncture in the case just mentioned revealed nothing but sterile fluid. In another case, in which the post-mortem confirmed the diagnosis of posterior-basic meningitis, the range of temperature for fifteen days was normal with the exception of one day, when it rose to 102° . In one case, which does not belong to the rubric described by Gee and Barlow and Still, inasmuch as the child was three years of age, the patient died after twenty-four weeks of illness, and only during the first four weeks of the sojourn in the hospital was there any temperature. During these four weeks it ranged as high as $105\frac{1}{4}^{\circ}$; during the remaining twenty weeks the temperature did not rise above the normal. In this case the child was admitted to the hospital on the seventh day of the disease, making a duration of twenty-five weeks.

Of the other symptoms of interest in these cases is, first, the condition of the fundus of the eye. In most of the cases below two years of age there was no change in the fundus; in other words, there was no optic neuritis, contrary to what is true of cases of

tuberculous meningitis, in which, in the majority of cases, there are changes in the fundus. In all of the cases of the Still type there were other signs which are generally included in the symptomatology of meningitis, such as *tâche cérébrale*, with evanescent erythemas due to vasomotor paresis. Kernig's sign in these cases is of very little value for two reasons: first, that these infants or children lie in a spastic or flexed position, and second, that in children below two years of age the presence or absence of Kernig's sign is a very difficult matter to substantiate. As to the Babinski reflex, in most cases it was absent; in others it might have been established in the course of the disease.

The leukocyte count in most of these cases is of great interest. In one case the leukocytes ranged from 14,000 to 17,000 to the cubic millimetre. In another case the leukocytes ranged from 10,000 to 30,000, the latter being the count at the close of the disease. In another case the leukocyte count was 19,000, the child dying three days after admission. In the case of an infant twelve months of age who was admitted on the twenty-fourth day of the disease the leukocyte count on admission was 26,000. It can thus be seen from this simple enumeration of the leukocyte counts that they were, as a rule, low, similar to what is seen in tuberculous meningitis, and therefore of no diagnostic value.

Of especial interest are the results of lumbar puncture. Our experience has been that lumbar puncture in posterior-basic meningitis is not always successful in evacuating fluid. In some of our cases we have proved that the cause of the so-called dry tap on lumbar puncture is due to the closing up of the canal of Magendie by exudate, and also the matting together of the spinal canal in the vicinity of the cerebellum and pons to such an extent that the subarachnoid fluid cannot flow from the subarachnoid space and ventricles of the brain into the space of the cord and out, and thus through the cannula in the lumbar region. In cases in which hydrocephalus had supervened and in which the disease had lasted for weeks, lumbar puncture was of only negative value so far as diagnosis was concerned, inasmuch as repeated puncture in such cases revealed a sterile fluid. Although the fluid in some cases was not quite clear, no micro-organisms were found either by spread or culture. This must be explained by the fact that in these cases the micro-organisms have really died out, and the few that remained were found only post-mortem, as in one case, in the ventricles of the brain.

Of the six cases below two years of age, which correspond absolutely to those described by Still, one gave a negative result by lumbar puncture, that is, only a few drops of fluid being obtained during life. In this case post-mortem examination of the fluid of the ventricles revealed the meningococcus. In another case, four months of age, although typical of the disease which we are describ-

ing, the lumbar puncture gave but little fluid, two or three cubic centimetres at each puncture, sterile of micro-organisms. In this case unfortunately there was no post-mortem. In another case, which had lasted twenty-four days on admission, the puncture fluid revealed meningococci. In the fourth case, four months of age, admitted in the sixth week of the disease, the first puncture fluid was negative, the second revealed meningococci. In this case post-mortem examination confirmed the diagnosis. In the fifth case the puncture fluid revealed meningococci. In the sixth case, nine months of age, which sojourned in the hospital five months, a large number of punctures was made. The case was absolutely characteristic of the type described by Still, although no post-mortem was obtained. Hydrocephalus resulted and increased under observation. At one puncture no less than 250 c.c. of fluid were removed and yet the most patient search failed to reveal any micro-organisms. This being a chronic case, the cytology of the fluid was especially interesting. It resembled very closely what is seen in tuberculous meningitis. There was a mononuclear picture of leukocytes. I have explained this mononuclear picture elsewhere as being characteristic of so-called chronic cases of cerebrospinal meningitis.

In these cases, as in hydrocephalus, there is really a transudate rather than an exudate. The inflammation has run its course, but the hydrocephalus is the result of transudation of serum from the vessels rather than of exudation due to active inflammatory processes, and, according to Ribbert, a transudate would reveal a predominance of mononuclear lymphocytes.

In the second case, four months of age, there was a polynuclear picture, with sterile fluid. In the third case, four months of age, there was a marked polynuclear picture of the puncture fluid, and in this meningococci were found. In the fourth case, in which diagnosis was confirmed by post-mortem examination, there was a predominance of polynuclear elements in the puncture fluid, and in this case meningococci were found. In the fifth case, an infant nine months of age, the puncture fluid presented a polynuclear picture, and in this case also meningococci were found. It may be said, therefore, that the chronic cases yielded negative results so far as micro-organisms in the puncture fluid are concerned, and that the mononuclear picture resembled what is seen in tuberculous meningitis.

Post-mortem examinations were obtained in three of the six cases occurring in children below two years of age. In one, an infant six months of age, post-mortem examination showed that the superior surface of the brain was pale, that the convolutions were flattened, and that at the base there was a small amount of organizing, purulent exudate. The floor of the fourth ventricle was bulging and ready to burst. The foramen of Magendie was almost $\frac{3}{4}$ cm. in diameter. The fluid aspirated from the ventricle showed meningococci. The

cord presented hemorrhages in the cervical, mid-dorsal, and lumbar regions.

The thymus was large, the lungs showed simple congestion, the heart muscle was pale, the spleen was moderately large, the Malpighian bodies quite large, and the liver was congested and somewhat fatty; the gall-bladder and duct were negative, the kidneys negative, the adrenals and pancreas negative; the stomach showed a few hemorrhagic areas in the fundus; the intestines showed follicular enteritis, swelling of the mucosa, vessels markedly injected, and the mesenteric nodes moderately enlarged.

In another case, an infant nine months of age, admitted on the seventeenth day of the disease, there was some purulent exudate over the vertex, but it was most marked at the base, completely surrounding the cord. There was considerable increase of the subarachnoid fluid, there was hydrocephalus, and marked dilatation of the ventricles.

In the third case, two years of age, admitted in the sixth week of the disease, post-mortem made at the end of the sixth week, examination of the brain revealed the dura adherent to the calvarium and the pia adherent to the dura mater over the motor areas on both sides. The brain was œdematous, with marked injection of the bloodvessels. There was an organized exudate of a yellowish-gray color on the surface of the brain. At the base, over the chiasm and anterior surface of the medulla and pons, and to a slight extent over the cerebellum anteriorly, there was a thick, grayish-yellow exudate. No tubercle. The ventricles were moderately dilated and contained some turbid fluid. The choroid plexus was congested, and a few petechiæ were scattered over the surface of the brain.

CASE I.—Male infant, aged four months; admitted May 31, 1904, in the twenty-fourth day of the disease.

Family History. Negative.

Previous History. Negative. Labor normal.

Present History. Child became ill twenty-four days before admission, with fever, crying out, painful rigidity of the neck, erythema over the general surface; eyes turned upward; no convulsions; occasional vomiting; fontanelles bulging; bowels and urination normal. There has been increasing loss of weight and slight cough. On admission, general condition fair, child well nourished. Head retracted to an extreme degree, no opisthotonos, feet drawn up on the abdomen, arms extended. Child cries when disturbed, otherwise quiet. Seems to notice objects. Sutures of the head still open, anterior fontanelle open and bulging; pupils react to light, no strabismus, no facial paralysis, no paralysis of the extremities. There is a Babinski reaction on both sides, often automatic; knee-jerks increased, no clonus; there is *tâche cérébrale*;

distinct trismus of the lower jaw, preventing a view of the throat. Skin, heart, lungs, liver, and spleen negative; abdomen rigid, without any palpable abnormality. There is shallow breathing, irregular in rhythm; pulse is of fair quality, but irregular.

Under observation there was occasional vomiting, this increasing until the child vomited after every feeding, always of projectile character. The rigidity and retraction of the head did not diminish. The fundus of the eye, examined by Dr. Gruening, gave a negative result.

On June 4 child's condition became worse to a marked degree; the pulse became very weak and rapid; the respirations, though rapid, continued irregular. The child took no nourishment, became slightly cyanotic, and lay with upper extremities in a condition of overextension, the fists clenched in the tetany position.

Lumbar puncture was made in this case on three different occasions, the first two punctures being negative, the third yielding 5 c.c. of a turbid fluid showing a marked preponderance of polynuclear leukocytes and numerous extracellular and intracellular Gram-negative diplococci, both by culture and stain.

The temperature in this case was normal until six hours before the exitus, which took place June 4, five days after admission. At this time, just before death, the temperature rose to $105\frac{1}{2}^{\circ}$. The range of pulse was very irregular—from 100 to 180 per minute. The respirations were irregular, ranging from 30 to 50 per minute. The leukocytosis in this case was 26,000 to the cubic millimetre. No post-mortem.

CASE II.—Male infant, aged four months; admitted to the service June 25, 1904, in the fifth week of the disease.

Family History. Negative.

Previous History. Negative, both as to infectious diseases and ear complications.

Present History. Infant became suddenly ill five weeks before admission, with fever, convulsions, and rigidity of the neck. Two weeks before admission the child went into a condition in which it lay quiet, with occasional contractions of the muscles of the arms and legs. At this time the mother noticed that the child no longer saw objects. Emaciation became marked, bowels constipated.

On admission, physical examination revealed an infant the general condition of which was poor. It lay very quiet, seldom cried. The head was retracted and there was some opisthotonos. The upper and lower extremities were adducted toward the trunk; the forearm, wrists, and fingers were flexed, the hands in the tetany driving position. The spastic condition of the lower extremities was so great that they could not be flexed beyond a slight angle, in which they were constantly held. There were periods of relaxation, however, in which the lower extremities could be flexed. The spastic condition of the upper extremities was very marked.

There were purposeless movements of the upper extremities, and a tendency to cross the legs. Reflexes at the knee were present, the great toe held in the Babinski position most of the time, but no true Babinski could be obtained; there was no clonus. The pupils reacted to light, of equal size; no strabismus. No facial paralysis. Anterior fontanelle prominent, posterior fontanelle closed; head not enlarged. No Macewen; ears and mastoid negative; marked signs of rachitis on the chest. Heart, lungs, liver, and spleen presented nothing of interest.

June 26th. Examination revealed an infant with body in a condition of spastic rigidity, with arching of the back, retraction of the head, with intervals in which the rigidity and opisthotonos are not so pronounced; fontanelles bulging; craniotables marked. A Babinski was obtained at this time; the hands still continued in the tetany position; arms rigid and extended; knees sometimes relaxed, at other times rigid. The occasional spasm which caused marked rigidity and arching backward of the head and body also affected the muscles of respiration, so that there was, when these spasms occurred, a crowing sound heard, formed in the larynx on inspiration. Trismus was present at times. A lumbar puncture was made on June 27, and 1.3 c.c. of a yellow, cloudy fluid obtained. The report on this fluid showed a cytological picture of a polynuclear type, but no meningococci. Spreads and culture negative.

The child died nine days after admission. During the whole stay in the hospital the temperature was normal with the exception of the second day, when it mounted to 101°. The pulse was very irregular, ranging from 104 to 150 during the stay in the hospital. The respirations ranged from 18 to 30.

CASE III.—Female infant, aged six months; admitted in the fourth week of the disease.

Family History. Negative. Mother has three other children.

Previous History. Negative, with the exception of a diarrhoea, at the age of two months, which lasted two weeks.

Present History. Infant has been sick four weeks. Illness began suddenly with fever and convulsions. Convulsions lasted two weeks and were repeated daily. Infant vomited once or twice. In the interval of the convulsions child lay perfectly quiet and did not cry. For the past two weeks there have been no convulsions. Mother thinks infant is blind and that the head is increasing in size. Slight cough for the last few days. Infant takes nourishment well. Bowels and urination normal. Child has lost in weight.

Physical examination shows condition good, well nourished; infant restless, head and extremities in constant motion. Skin presents nothing peculiar; small glands are felt in the neck and groin, none elsewhere. There is rigidity of the neck; no Kernig, no Babinski; knee-jerk present; no clonus; strabismus, pupils react to light, are equal, moderately dilated; no facial paralysis; tache

cérébrale; tongue slightly coated. Heart, liver, and spleen normal. Abdominal wall rigid; abdominal contents present nothing peculiar. Child vomits its nourishment. Respiration irregular; at times child does not appear to breathe. Fontanelles bulging, head retracted. Child continued in this condition without very much change until just before death, which occurred quite suddenly.

While in the hospital on the first day the temperature reached 101° , on the second day $102\frac{4}{5}^{\circ}$, and on the third day of the sojourn in the hospital it dropped to normal and remained there until the exitus. The pulse was quite irregular, ranging from 100 to 130, respirations from 30 to 34.

Both eyes, examined by Dr. Gruening, showed optic atrophy.

Culture of the cerebrospinal fluid during life gave a negative result, but that removed after death showed meningococci and a polynuclear leukocytic picture.

Post-mortem. Thymus enlarged; lungs somewhat congested; heart muscle pale, foramen ovale open; spleen moderately enlarged, Malpighian bodies enlarged; kidneys negative; adrenals and pancreas negative; stomach, a few hemorrhagic areas in the fundus; intestines showed follicular enteritis, mucosa congested, and nodes enlarged. Brain surface pale, convolutions flattened; ventricles distended with fluid at the base a small amount of purulent exudate; floor of the fourth ventricle ready to burst, foramen of Magendie 2.3 cm. Cord showed hemorrhages in the cervical and dorsal regions underneath the pia.

CASE IV.—Female infant, aged nine months; admitted May 12, 1904, in the seventeenth day of the disease.

Family History. Negative.

Previous History. Negative, with the exception that there was a discharge from the right ear two months ago which lasted four weeks.

Present History. Infant was taken suddenly ill seventeen days ago, with fever, 104° according to the statement of the physician in charge. There was no cough and no convulsions. Rigidity and retraction of the head present for the last fifteen days. There was occasional vomiting; intestinal movements normal at first, but lately have become green, containing mucus.

Physical examination shows well-nourished infant; head retracted; neck rigid; pupils contracted, react to light. No Kernig, no Babinski; knee-jerks markedly increased; no clonus. *Tâche cérébrale*; hyperæsthesia; no meningeal cry; no rash on extremities, body, or mucous membranes. Fontanelles depressed. Respirations very irregular. Lungs, heart, and liver normal; spleen palpable below the borders of the ribs; abdomen relaxed.

Child continued very much in the same condition during its stay in the hospital, with the exception that on May 23d physical examination revealed the head more and more retracted, so that it formed

almost a right angle with the spine. Respirations shallow and very irregular, fontanelle not bulging; there is slight convergent strabismus; no facial paralysis. Child cries out without any cause, takes its food very poorly. There is marked *tâche cérébrale*, increased knee-jerks; opisthotonos is marked, though there are periods of relaxation during which the opisthotonos disappears. The retraction of the head, however, remains constant.

Examination of the blood showed leukocytosis ranging from 15,000 to 30,000 to the cubic millimetre.

Lumbar puncture revealed cerebrospinal fluid decidedly cloudy, showing a preponderance of polynuclear leukocytes, Gram-negative staining diplococci intracellular and extracellular both by spread and culture.

The temperature during the stay in the hospital was normal with the exception of the seventh day, when it rose, without apparent cause, to 101°, then dropped to normal, finally falling to subnormal just before death. The pulse was quite irregular, ranging from 80 to 160 per minute. The respirations were 20 to 38 per minute.

The urine showed amorphous urates and a few leukocytes.

Post-mortem examination, made of the brain only, showed a purulent exudate over the vertex and a marked exudate at the base, completely surrounding the cord. The ventricles were dilated and contained an increased amount of fluid. Brain not opened.

CASE V.—Female infant, aged nine months; admitted March 29, 1904, in the tenth week of the disease.

Family History. Negative.

Previous History. Difficult and prolonged labor. Child was born perfectly normal.

Present History. Infant was taken suddenly ill ten weeks before admission, with fever, stupor, and retraction of the head. The child continued from this time on with occasional fever and in a stuporous condition. Three weeks before admission it developed general convulsions, these convulsions being frequently repeated. The head became a great deal larger, there was a slight cough, and marked emaciation.

On admission the general condition of the child was very poor, emaciated, head retracted to extreme degree, marked opisthotonos. Forearm flexed on the arm, hands held in the driving position; lower extremities extended and the feet in the equinovarus position. Eyes prominent, head considerably enlarged, marked prominence of forehead and occiput; anterior and posterior fontanelles open, with bulging of the anterior fontanelle; separation of the bones of the cranium at the sutures. Macewen percussion note obtained on both sides of the skull. Incisors of the lower jaw present; slight trismus of lower jaw. *Tâche cérébrale*. Examination of the fundus of the eye negative.

This child was punctured eight times, from 40 to 250 c.c. of fluid

being withdrawn at each puncture. The puncture fluid was carefully centrifuged and repeatedly examined, with a view to finding meningococci, but none were found, nor were tubercle bacilli found. Cultures were made, with negative results, as were also injections into animals.

This infant was in the hospital six months, during most of which time the temperature was normal. There were periods, however, of a week in which the child ran a very irregular temperature, especially the first week of its sojourn in the hospital, when it ranged from subnormal to 104.6°. These temperatures were higher after lumbar punctures. After the second week the temperature remained normal.

The blood count, taken during the course of the disease, showed leukocytosis ranging, in the first week, from 9000 to 17,000, after which it remained low, not exceeding 10,000.

The pulse was very irregular, ranging from 100 to 160 per minute on different days. Respirations also were irregular both in rhythm and depth, ranging from 15 to 30 per minute.

Although the infant continued in the hospital for six months the head steadily enlarged in spite of the withdrawal of fluid. The emaciation came to a standstill at a certain point, and then the infant increased very slightly in weight, remaining thus until its withdrawal from the hospital.

Unfortunately there was no post-mortem, but the whole picture of the disease clinically was that of hydrocephalus following cerebrospinal meningitis, with extreme retraction of the head and opisthotonos which were constant, accompanied by tetany in the extremities and trismus of the jaw.

CASE VI.—Female child, aged two years; admitted April 25, 1904, in the fifth week of the disease.

Family History. Negative.

Previous History. Normal labor, breast-fed child. One year before admission had an abscess in the neck extending over three weeks; otherwise has been a bright, healthy child.

Present History. Five weeks before admission child was taken suddenly ill, with fever, general convulsions. Since the onset there have been, at times, remissions of the fever, though it has continued more or less up to the present time. The child has gradually become stupid, though the father thinks it is not blind. It vomits occasionally, and for the past three days there have been constant movements of the upper and lower extremities. The child has emaciated markedly. Bowels and urination normal. The father has noticed that the child's head has perceptibly enlarged during the illness.

Physical examination of the child shows that it lies with the head retracted, eyes wide open, head turned to the left. The body is arched and the neck rigid. There are occasional purposeless movements of the forearm and arms and sometimes of the lower

extremities. At times there seem to be coarse tremors of the upper extremities. The child starts at the least sound. The respirations are irregular and shallow. At times the extremities are held in a spastic condition, the feet being in a condition of extension, the arms flexed at the elbow, the fingers and toes flexed. In other words, the hands are clenched and the lower extremities are in a spastic condition similar to that seen in tetany. The pupils are equal, though widely dilated, but react to light. There is slight nystagmus. At times the arching of the back relaxes, but as soon as the muscles of the back are irritated the arching becomes extreme. Macewen's sign is marked, especially on the right side. The eyes show no optic neuritis or change in the fundus. Lung, heart, and liver negative; spleen congested, palpable below the free border; abdomen rigid, scaphoid in shape. On account of the trismus of the lower jaw the mouth cannot be opened or the throat examined.

Lumbar puncture reveals fluid in which there is an abundance of polynuclear elements, to the extent of 73 per cent., and 27 per cent. mononuclear. There are extracellular and intracellular diplococci not staining with Gram.

The child died suddenly without any change in the symptoms four days after admission.

The blood count the day after admission showed a leukocytosis of 19,200 to the cubic millimetre.

The temperature was normal during the child's stay in the hospital, with the exception of one day, when it rose to $101\frac{1}{2}^{\circ}$ without any apparent cause. The pulse ranged from 100 to 140, and the respirations from 26 to 48.

Post-mortem examination showed that the dura mater was adherent to the calvarium and the pia mater to the dura mater over the motor areas on both sides. The brain was markedly oedematous, with pronounced injection of the vessels. There was a moderate amount of organized exudate of a yellowish-gray color on the surface of the brain. There was an increase of the subarachnoid fluid at the base of the brain; over the chiasm, anterior surface of the medulla, pons, and, to a slighter extent, over the cerebellum anteriorly, there was a thick, grayish-yellow exudate. The ventricles were moderately dilated, containing a turbid fluid. The choroid plexus was injected and there were a few petechiæ scattered over the surface of the brain.

Meningococci were found in the exudate at the base of the brain.

The above six cases are a series occurring in children two years of age and below, corresponding quite closely to what has been described recently by Still. All the clinical features of these cases were similar, and all presented the marked head retraction described by Gee, Barlow, Lees, and Still as characteristic of these cases. They all occurred in the course of an *epidemic of cerebrospinal meningitis* of a very extensive nature, prevalent among both children and adults,

and were admitted, with twenty-four other cases of cerebrospinal meningitis, to my hospital service. These cases were admitted at more or less advanced periods of their affection, as may be seen by reference to the histories, and none of them recovered. One case was discharged with increasing symptoms of hydrocephalus, as may be seen from the notes. It was, however, in a very poor physical condition at the time of its discharge.

The leukocyte count, as may be seen, was not very high in any case, and the lumbar punctures were unsuccessful in those cases in which the canal of Magendie was proved post-mortem to have been either narrowed or completely obliterated.

The question has arisen as to the exact causes of the peculiar features of these cases—that is, first, the retraction of the head, and, second, the hydrocephalus. Carr, in the *Medical and Chirurgical Transactions* of 1897, has attempted to explain the hydrocephalus as due, first, to obliteration of the foramen of Magendie, thus allowing an accumulation of fluid in the ventricles for which there is no escape; and second, to pressure of the exudate at the base, and in some cases thrombosis of the veins of Galen, resulting in a transudation or dropsy, so to speak, of the ventricles.

As to the retraction of the head, it has been explained by Still and his predecessors as due to an irritation of the cervical nerves as they emerge from the intervertebral notches, thus causing a contraction of the smaller deep muscles of the neck.

Whatever the cause of the head retraction and the hydrocephalus in these cases, these two features are peculiar to them, and do not necessarily occur in forms of basic meningitis at a later period of life; nor does the fact that this form of meningitis is peculiar to infants necessarily exclude its occurrence at a later period.

I have been fortunate to observe a case of basic meningitis occurring in a boy five years of age, in which post-mortem examination revealed a typical meningitis of the Still type, due to streptococcus infection. In this case there was no retraction of the head; in fact, as will be seen from a study of the history of the case, the signs of meningitis were almost equivocal. Only slight rigidity of the neck, increasing stupidity, a Kernig sign, and *tâche cérébrale* led to the suspicion that meningitis might be present. In other words, basic meningitis may occur at a later period in life without the characteristic symptoms seen in infants below two years of age.

CASE.—*Basic meningitis due to streptococcus infection, occurring in a boy aged five years.*

Family History. Negative.

Previous History. Normal birth; no traumatisms. Measles at age of one year; slight attack of pneumonia at two years of age. When four years old (one year before admission) he fell; was not unconscious, but was confined to bed for three weeks with high

fever, loss of appetite; vomited once, immediately after the fall; no other symptoms. Boy recovered completely.

Present History. The boy came under observation September 2, 1904. At that time he complained of headache and had a slight cough.

Examination revealed that the boy had febrile movement from 103° to $105\frac{1}{2}^{\circ}$; pulse from 120 to 128; respirations 20 to 24. Examination of the lung gave equivocal signs. There was slight dulness over the right lung and diminished breathing behind.

Fever continued in the remittent curve from 101° to $104\frac{1}{2}^{\circ}$, and reaching $105\frac{1}{2}^{\circ}$. Respirations 20 to 24. Leukocyte count of 8000. Aside from headache there were no signs of meningitis before admission.

On admission of the boy to the hospital physical examination showed that he was slightly stupid, complained of sore throat, which was negative on inspection; temperature had the same curve, as noted above. There was dulness of the right lower lobe, behind and in the axilla; slightly diminished breathing. Heart was negative.

So slight were the signs of meningitis that the boy was rather suspected to have had typhoid, but the Widal test was made with negative results. The leukocyte count, however, mounted to 25,400. On the fourteenth day of the disease the boy became semi-stupid, developing rigidity of the neck and a Kernig sign. Lumbar puncture was made and a turbid fluid obtained, showing a preponderance of polynuclear leukocytes; abundant streptococci, both on spread and culture. The boy became more stupid, developed strabismus of the left eye, and there was considerable hyperæsthesia and irritability. Examination of the fundus showed optic neuritis of the left eye. Strabismus was supplemented with flatness of one side of the face. Patient developed conjunctivitis; the pupils were uneven and did not react to light. The lung developed a few subcrepitant rales over the upper part of the right lung in front and behind, with small areas of dulness. Spleen not palpable. Heart and liver negative. There was a leukocyte count before death of 18,000 to the cubic millimetre. The temperature of this case during the stay in the hospital was exceedingly irregular. It was of the remittent type, at times reaching $104\frac{1}{2}^{\circ}$ and falling as low as 99° . On some days the temperature did not fall to normal; on other days it fell to normal, but immediately rose again to the figures mentioned. The pulse was extremely irregular, varying from 96 to 140 at various stages of the disease. The respirations were 24 to 32.

Post-mortem revealed a pure type of basic meningitis, the exudate at the base extending as far forward as the tips of the temporo-sphenoidal lobes. There was absolutely no exudate on the superior and lateral surfaces of the brain, although there was marked congestion of these areas. The purulent exudate did not extend down into the spinal cord. The ventricles were dilated and contained

a turbid fluid. Lungs showed hemorrhagic areas of bronchopneumonia scattered through both lungs.

Here was a case, it will be seen, of classical basic meningitis due to streptococcus infection, possibly from the lungs. A careful examination of the ears post-mortem throughout the bony construction showed absolutely nothing abnormal, nor could the avenue of infection be traced in this case. During life the symptoms of meningitis in this case were so non-characteristic as to lead two physicians whose powers of observation are undoubted to think of typhoid fever, or of some obscure disease other than meningitis. It was only in the later stages of the meningitis, when the stupor became evident and the rigidity of the neck marked, accompanied by Kernig's symptom, *tâche cérébrale*, and paresis of the facial nerves and ocular muscles, that meningitis was thought of. Lumbar puncture confirmed the suspicion. At no time in the course of the disease was there retraction of the head.

There are thus, according to the author's interpretation, two forms of basic meningitis. The first, which is primary, corresponds to the type described by Still, in which there is a primary inflammation of the meninges, as described in his paper, caused by the *diplococcus intracellularis* of Weichselbaum; and the second, occurring in older children, in which the symptoms in no way resemble those of the cases described by Still and the set described in this paper.

The cases occurring in older children may be complicated with pneumonia, as in the case last quoted, or may be secondary to a pneumonia. The characteristic symptomatology is evidently lacking, but there may occur certain symptoms which will point to a basic involvement, as in our case, such as facial paresis and paralysis of the muscles of the eye.

It is interesting, however, to note that cases of basic meningitis of the type described by Gee, Barlow, Lees, and Still may occur in epidemics of cerebrospinal meningitis, and be due to the same essential cause as the disease which occurs in older children. In fact, it seems that in the majority of cases of children attacked by cerebrospinal meningitis below two years of age the symptomatology is so closely allied—in reality identical—with that described by Gee, Barlow, and Still that the conclusion is inevitable that cerebrospinal meningitis, both epidemic and sporadic, in young children takes the form described by these authors in a certain set of cases.

NOTE.—The bacteriological and pathological data of this paper emanate from the pathological laboratory of the Mount Sinai Hospital, New York.